THE SOLAR PERIOD THE BASIS OF CHRONOLOGY.

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THE SOLAR PERIOD THE BASIS OF CHRONOLOGY.

THE ſun being placed in the center of the univerſe, the earth, as a planet, revolves round it in 365 days, 5 hours, 49 minutes, or in 525949 minutes; which conſtitute an aſtronomical, or ſolar tropical year: in which time, the ſun appears to have paſſed through all the ſigns of the zodiac.

By not attending to this quantity of the ſolar year, and meaſuring our time by the ecliptic, we have had a retroceſſion of forty-four days, and almoſt two hours, ſince the world is ſuppoſed to have been created; whereas, if time had been computed on the terreſtrial equator, by the mean aſtronomical year, the equinoxes muſt always have fallen on the ſame days of the month which they originally happened on, and no ſuch anticipation could ever have been.

The ſun hath two remarkable periods; one of 1440 tropical years, the number of minutes in a natural day; the other conſiſts of 10080 years, having as many compleat weeks as there are minutes in one year: and as one day is an aliquot part of the leſſer cycle of 1440 years, ſo is one week an aliquot part of the greater cycle of 10080 years, (to wit) a 525949th part.

At the end of the leſſer period, the ſun enters libra *on the ſame day of the month*, and at the ſame hour and minute, in which it was at the beginning; but not on the ſame day of the week.

At the end of the larger cycle, or period of 10080 years, *and not ſooner*, it enters the ſame cardinal point, not only on the very day of the month, *but alſo on the ſame week-day*, and in the ſame moment, wherein it was at the commencement of time, allowing for the retroceſſion aforementioned. And the two equinoxes regularly fall in every

year, 5 hours 49 minutes later in the day, than in the year preceeding; whence it may be inferred, that a mean tropical ſolar year contains preciſely 365 d. 5 h. and 49 min. *

The mean Julian year (by which our time is ſtill computed) hath 365 days, 6 hours; and exceeds the tropical year by 11 minutes.

This annual exceſs of 11 minutes, in the ſpace of 131 Julian years, amounts to 1 day and 1 minute; in 1310 years it comes to 10 days and 10 minutes; and in 130 years more (which makes a compleat period) it increaſes 23 hours and 50 minutes, making in all 11 days anticipation in 1440 years.

Which conſideration ſeems to have induced our legiſlature in their correction of the calendar, to reject 11 days in the autumn of the year 1752; for as the third ſolar period ended in the year of our Lord 313, ſo the fourth ended at the autumnal equinox 1753.

The firſt autumnal equinox is here ſuppoſed to have been in the 706th year of the Julian period, on *Thurſday* October the 25th, (or 298th day from the kalends of January) preciſely at noon.

At the end of the firſt ſolar period, A. M. 1440, it fell on *Monday* October the 14th; at the end of the ſecond period, A. M. 2880, it fell upon *Friday* October the 3d; at the end of the third period, A. M. 4320, A. D. 313, it fell on *Tueſday* September the 22d; and at the end of the fourth period, A. M. 5760, A. D. 1753, it fell upon *Saturday* the 11th of September, old ſtyle, the 22d new ſtyle; regularly anticipating 11 days at the end of each period, and the day of the week ſhifting four days later, in every revolution of 1440 years.

To prevent the like anticipation for the future, the correctors of the calendar have ordered three biſſextiles to be rejected in 400 years, which is as near as they could calculate in round numbers; the true aſtronomical difference being 3 days, and 3 minutes, in 393 years,

It is remarkable, that the number of the ſolar period bears as true a proportion to the meaſure of the equator, as to the minuter parts of time; for as one day hath 1440 minutes, (which are four times the number of degrees) ſo 4 minutes are equal to 1 degree; and by this proportion we ſettle meridian diſtances.

For example, If a celeſtial phænomenon happens in any meridian preciſely at noon, it muſt, at the ſame inſtant of time, be 10 hours 24 minutes after noon, in a meridian that lies 156 degrees to the eaſtward thereof.

Note,

* See the Poſtſcript.

Note, there are four quadrants in a day, of ſix hours each; one Julian year hath 1461 ſuch quadrants, and four Julian years contain as many days: wherefore in the reduction of Julian years to days and hours, we multiply them by 1461 quadrants of a day, and divide the product by 4 quadrants.

And to know the retroceſſion, or Julian exceſs, of any given number of years, multiply thoſe years by 11 minutes, then divide the product by 1440, and the remainder (if any) by 60.

Having found the Julian reduction of the given years, ſubſtract therefrom the Julian exceſs of the ſame years, and the difference will be the ſolar tropical reduction of thoſe years, in days, hours, and minutes, computed from Thurſday the 25th of October, in the 706th year of the Julian period.

And if the days * of the ſolar tropical time are divided by 7, the quotient will be the number of weeks elapſed, and the remainder will ſhew the current day of the week; for if 0 remains, it is Thurſday; if 1, it is Friday; if 2 remains, it is Saturday, and ſo on.

Hence we collect the following rules for diſcovering the time of an autumnal equinox.

Firſt, Find the Julian and tropical reductions of the given year, as before directed.

To the ſolar tropical time add 298 † days, to make the years commenſurate, becauſe the Julian year began with the kalends of January, and the tropical year from the 25th of October, between which, there are 298 days incluſively taken.

From the ſum of that addition, ſubſtract the days in the Julian reduction, and the remainder (counting from the firſt of January incluſive) will ſhew the Julian month, day of the month, hour, and minute of the equinox.

And having found the day of the week in the manner aforementioned, by the literal character of the day of the month, you diſcover the dominical letter for that year.

To exemplify theſe rules, let it be required to ſhew the true time of the ſun's entry into libra, in the ſeveral years of our Lord 1752, 1753, 1754, and 1755.

* When the hours in the tropical reduction exceed 12, take one day more to be divided by 7.

† In a biſſextile year add 297 days only.

4713 years of the J. P. before Chriſt.
1752 ſince Chriſt.
6465 current year of J. P.
− 706
5759 the interval, or the year of the world, biſſextile.

5759
1461
5759
34554
23036
5759
4) 8413899
2103474 18 00 Jul. reduct.
43 23 49
2103430 18 11 tropical reduction *.
+ 297
2103727 18 11
2103474
253 18 11
Add 11 d. for N. S. and 10 h. 24 min. for merid. diſtance } 11 10 24
265 4 35 at Greenwich.
Subſt. for Jan. Feb. &c. to the end of Aug. } 243
Friday, Sept. 22 4 35

5759
5759
1440) 63349 (43 days.
5760
5749
4320
60) 1429 (23 hours.
120
229
180
49 minutes.
7) 2103431 p. m. n.
300490 + 1 Friday.

Literal character Sept. 22 is F, which being Friday, the dominical letter was A.

A. D.

* If only the tropical reduction be required, multiply the years of the world by 525949, and divide by 1440, the quotient will yield the days, hours and minutes.

A. D. 1753
4713

6466
- 706

A. M. 5760

5760
5760

1440) 63360 (44 days excefs.
5760

5760
1461

5760
34560
23040
5760

4) 8415360

2103840 the Julian reduction.
- 44

2103796 the tropical reduction.
+ 298

2104094
- 2103840

254 00 00

Add for N. Style 11 d. and for merid. diftance, 10 h. 24 m. } 11 10 24

265 10 24 at Greenwich.
Deduct to the end of Aug. 243

Saturday, Sept. 22 10 24 p. m.

5760
5760

00

7) 2103796

300542 + 2 Saturday.

Literal character F, which being Saturday, the dominical letter G.

A. D.

A. D. 1754, A. M. 5761.

5761
11
D. H. M.
1440) 63371 (44 0 11
5760

5771
5760

60) 11 (0
00

11

5761
1461

5761
34566
23044
5761

4) 8416821

2104205 6 0
44 0 11

2104161 5 49 tropical reduction.
298

2104459
2104205

7) 2104161

254 5 49 300594 + 3 Sunday.
Add 11 d. and 10 h. 24 min. 11 10 24

265 16 13 at Greenwich.
243

Sunday, Sept. 22 16 13

Literal character F.
Dominical letter F.

A. D.

A.D. 1755, A.M. 5762.

```
                                        5762
                                        5762
                                      -------
                                1440) 63382 (44   0 22
                                      5760
                                      -------
                                        5782
                                        5760
                                      -------
                                          60)  22 (0
                                               00
                                               --
                                               22

    5762
    1461
   -----
    5762
   34572
  23048
  5762
 -------
4) 8418282
 -------
 2104570 12 00
      44  0 22
 -------------
 2104526 11 38  tropical reduction.
     298
 -------
 2104824
 2104570
 -------
     254 11 38                  7) 2104526
   +  11 10 24                     ------
   ----------                     300646 + 4 Monday.
     265 22  2  at Greenwich.
     243
     ---
Monday, Sept. 22 22  2
```

Literal character F.
Dominical letter E.

If this method be thought too prolix, make uſe of the following table, conſtructed as a mean to reconcile diſagreements in obſervation.

TABLE OF INTERVALS.

Years.	H.	M.	Years.	H.	M.
9000	6	0	90	19	30
8000	21	20	80	9	20
7000	12	40	70	23	10
6000	4	0	60	13	0
5000	19	20	50	2	50
4000	10	40	40	16	40
3000	2	0	30	6	30
2000	17	20	20	20	20
1000	8	40	10	10	10
900	3	0	9	4	21
800	21	20	8	22	32
700	15	40	7	16	43
600	10	0	6	10	54
500	4	20	5	5	5
400	22	40	4	23	16
300	17	0	3	17	27
200	11	20	2	11	38
100	5	40	1	5	49

In the 706th year of the Julian period, from whence we date our chronology, the ſun (had the world been then created) muſt have entered into aries the 21ſt of April, or 111th day from the kalends of January, at 9 minutes after midnight; and was in libra on the 25th of October, or 298th day, preciſely at noon.

Wherefore it is ſufficient for chronological uſe, if we ſubſtitute as an epoch

for aries - 111 d. 12 h. 9 min.
and for libra - 298 0 0

But in a biſſextile year, and the firſt after, unleſs it be the laſt year of a ſolar period, we take for each radix one day leſs, viz.

for aries - 110 d. 12 h. 9 min.
for libra - 297 0 0

Application

Application of the Table of Intervals.

Seek in the table the hours and minutes anſwering to the interval of years, which add to the epoch.

Deduct the number of days retroceſſion of the given years, and the remainder will be the time ſought, to which add 10 hours, 24 minutes, to bring it to Greenwich obſervatory.

Q. *The ſun in libra* 1752?

The retroceſſion of 5759 years, allowing for new ſtyle, is 33 days.

		H.	M.	
5000	years	19	20	
700	- -	15	40	
50	- -	2	50	
9	- -	4	21	
For the interval	-	18	11	to be taken in.

A. D. 1752 was biſſextile, therefore the epoch is but 297.

	D.	H.	M.	
Epoch	297	0	0	
Interval		18	11	
	297	18	11	
-	33			
	264	18	11	
+		10	24	
	265	4	35	
	243			
Sept.	22	4	35	at Greenwich.

A. D. 1753, A. M. 5760, end of the fourth period. Interval 0, retroceſſion 33.

	D.	H.	M.	
Epoch	298	0	0	
		0	0	
	298	0	0	
-	33			
	265	0	0	
+		10	24	
	265	10	24	
	243			
Sept.	22	10	24	at Greenwich.

A.D. 1754 fell in with A.M. 5761.
Interval of 1 year 5 h. 49 min.

	D.	H.	M.
Epoch	298	0	0
+		5	49
	298	5	49
−	33		
	265	5	49
+		10	24
	265	16	13
	243		

Sept. 22 16 13 at Greenwich.

A.D. 1755, A.M. 5762. Interval of 2 years 11 h. 38 min.

	D.	H.	M.
Epoch	298	0	0
+		11	38
	298	11	38
−	33		
	265	11	38
+		10	24
	265	22	2
	243		

Sept. 22 22 2 at Greenwich.

The foregoing computations from the 706th year of the Julian period, compared with the obſervations taken at Greenwich by Dr. Bradley, in the years 1752, 1753, 1754, and 1755.

Calculated Times.					Dr. Bradley's obſerved Times.				
1752.	Sept.	22	4	35	1752.	Sept.	22	4	32
1753.	-	22	10	24	1753.	-	22	10	24
1754.	-	22	16	13	1754.	-	22	16	14
1755.	-	22	22	2	1755.	-	22	22	4

The epochs for the two other cardinal points, are

for cancer - -	204 d.	10 h.	51 min.	July 23
for capricorn -	387	15	57	January 22.

POSTSCRIPT.

POSTSCRIPT.

I Should have thought what is premiſed, ſufficient to have deduced this ſingle propoſition, that 365 d. 5 h. 49 min. are the mean quantity of a ſolar tropical year; if the ingenious Authors of the MONTHLY REVIEW for *June* 1763, had not thrown a ſtumbling-block in my way. For in the page 435 they are pleaſed to ſay, " We do not deny, though " we think it doubtful, that a period can be aſcertained in which the " different revolutions of the earth, may be completed exactly at the " ſame inſtant."

Now for removing this doubt, I ſhall make choice of the longeſt period hitherto aſſigned either by the ancients or moderns, and that is the grand Platonic year, or great period of 25920 years; in which compaſs of time, the equinoctial points will paſs through every degree of the ecliptic.

And ſuppoſing the mean tropical year to be of the preciſe length aforementioned, I ſhall inquire in what ſpace of time the preceſſion of the equinox (which Sir Iſaac Newton tells us, amounts to 50 ſeconds of a minute of a degree (that is) to 50 twelve hundred ninety ſix thouſandth parts of 360 degrees in one year, and to a whole degree in 72 years) will meaſure the whole circle of the ecliptic?

And this I ſhall do by reducing 50 ſeconds of a minute of a degree, to ſolar tropical time, meaſured by the aforeſaid mean quantity of a year, according to which

One tropical year is 365.242361

which multiplied by 50, and divided by 1296000, the quotient will be .014091 14047496570 which quotient reduced to time, will be equal to 0 h. 20 min. 17 ſec. 28 thirds, 28 fourths, 20 fifths, for the preceſſion of the equinox in one year.

The ſame quotient multiplied by 72 years will give for one degree, 1.01456211419753086419 &c. equal in time to 1 d. 0 h. 20 min. 58 ſec. 10 thirds; and this laſt product multiplied by 20, will give 20.291242283950617 28 &c. for 20 degrees; equal to a period of 1440 years, and equal in time to 20 d. 6 h. 59 min. 23 ſec. 20 thirds.

From which quantity, or amount of the preceſſion of the equinox, in one period of 1440 years, the following table is conſtructed.

TABLE

TABLE of PERIODS.

Periods.	Years.	Deg.	S.	D.	D.	H.	Min.	Sec.	Th.
1	1440	20	0	20	20	6	59	23	20
2	2880	40	1	10	40	13	58	46	40
3	4320	60	2	0	60	20	58	10	0
4	5760	80	2	20	81	3	57	33	20
5	7200	100	3	10	101	10	56	56	40
6	8640	120	4	0	121	17	56	20	0
7	10080	140	4	20	142	0	55	43	20
8	11520	160	5	10	162	7	55	6	40
9	12960	180	6	0	182	14	54	30	0
								× by 2	
18	25920	360	0	0	365	5	49	0	0

By this calculation it appears, that in a period of 25920 years, measured by the quantity of 365 d. 5 h. 49 min. to one year, the preceſſion of 50 ſeconds of 1 minute of 1 degree per annum, will complete the circle of the ecliptic; and that 360 degrees reduced to ſolar tropical time, are equal to the ſame mean quantity of a year, as the preceſſion of one year amounts to 0 h. 20 min. 17 ſec. 28 thirds, 28 fourths, 20 fifths; which, if not ſufficient to clear the aforementioned doubt, I ſhall leave the ſolution thereof to the Reverend Author named in the Review.

FINIS.